CLAIMS

1. A surveying system, comprising:

a position relation calculating processor that calculates a positional relation between a coordinate system to which measurement information of a measurement point refers and a schematic image of a surveying field, in which said schematic image includes a staking point;

a correspondence establishing processor that establishes correspondence between three-dimensional position information of said staking point and two-dimensional position information of a point corresponding to said staking point on said schematic image; and

an image processor that superimposes a symbol for indicating the position of said staking point on said schematic image in accordance with said correspondence.

2. A system according to claim 1, further comprising a surveying device that is able to obtain said measurement information for said measurement point.

3. A system according to claim 2, wherein said positional relation is calculated from a relation between three-dimensional measurement information of control points which is obtained by said surveying device, and two-dimensional position information of a point corresponding to said control points on said schematic

image, and wherein said control points are designated on said schematic image.

4. A system according to claim 2, wherein said surveying device comprises an image capturing device that is able to capture a magnified image which has a higher magnification relative to said schematic image, and wherein said magnified image of a sighting direction of said surveying device can be superimposed on said schematic image.

5. A system according to claim 1, wherein said correspondence establishing processor further establishes correspondence between said measurement information of said measurement point and two-dimensional position information of a point corresponding to said measurement point on said schematic image, and said image processor is able to indicate the position of said measurement point on said schematic image.

6. A system according to claim 5, wherein said measurement information of said measurement point comprises known measurement information.

7. A system according to claim 6, wherein said known measurement information comprises given geographical data, and said image processor superimposes a symbol for indicating the position corresponding to said given geographical data on said schematic image.

8. A system according to claim 1, wherein representation of said staking point before completion of a staking operation and after completion of said staking operation is different.

9. A system according to claim 1, wherein said image processor generates a plan view that indicates at least one of the relations between the position where said schematic image is captured, the position of said staking point, the position of said measurement point, and the position of said surveying device.

10. A system according to claim 1, wherein said image processor further superimposes secondary surveying information on said schematic image, and said secondary surveying information is derived on the basis of relations between said staking point and said measurement point.

11. A system according to claim 1, wherein said image processor further superimposes secondary surveying information on said schematic image, and said secondary surveying information is derived on the basis of relations between a plurality of said measurement points.

12. A system according to claim 10, further comprising

an image indicating device that indicates said schematic image on a screen; and

an input device that enables a designation of a point on said screen of said image indicating device;

wherein the positions of said staking points and said measurement points relating to said secondary surveying information are determined by designating at least two points from said staking points and said measurement points on said schematic image by using said input device.

13. A system according to claim 11, further comprising

an image indicating device that indicates said schematic image on a screen; and

an input device that enables a designation of a point on said screen of said image indicating device;

wherein the positions of said measurement points relating to said secondary surveying information are determined by designating at least two points from said plurality of measurement points on said schematic image by using said input device.

14. A system according to claim 1, further comprising an image indicating device, and said schematic image, on which a position of said staking point is indicated, can be displayed on a screen of said image indicating device.

15. A system according to claim 1, further comprising a printer, and said schematic image, on which a position of

said staking point is indicated, can be printed.

16. A system according to claim 1, wherein said image processor superimposes a symbol for indicating a position of a target on said schematic image, and wherein said target is measured so as to carry out staking out surveying for said staking point.

17. A system according to claim 16, wherein said image processor superimposes a distance between said target and said staking point on said schematic image.

18. A system according to claim 16, wherein said image processor superimposes a direction in which said target should be moved for said staking out surveying, on said schematic image.

19. A system according to claim 1, wherein said image processor superimposes measurement information of said measurement point on said schematic image.

20. A system according to claim 1, further comprising an inner orientation parameter calculating processor that calculates inner orientation parameters of a camera which captured said schematic image, in accordance with a relation between measurement information of a plurality of control points and two-dimensional position information of said control points on said schematic image.

21. A system according to claim 20, further comprising,

an image indicating device that indicates said schematic image on a screen; and

an input device that enables a designation of a point on said screen of said image indicating device;

wherein a position of said control point is arbitrarily designated on said schematic image displayed on said screen by using said input device.

22. A system according to claim 1, wherein said positional relation is calculated from a relation between given three-dimensional measurement information of a plurality of control points and two-dimensional position information of said control points on said schematic image.

23. A system according to claim 1, wherein said image processor superimposes said three-dimensional position information of said staking point on said schematic image.

24. A system according to claim 1, further comprising a data recording processor that is able to associate and record said three-dimensional position information of said staking point, said measurement information of said measurement point, and image data of said schematic image.

25. A system according to claim 1, further comprising a personal digital assistant, wherein said personal

digital assistant comprises said image processor.

26. A personal digital assistant which is used in a surveying system that comprises a position relation calculating processor that calculates a positional relation between a coordinate system to which measurement information of a measurement point refers and an image of a surveying field, in which said image includes a staking point, and a correspondence establishing processor that establishes correspondence between three-dimensional position information of said staking point and two-dimensional position information of a point corresponding to said staking point on said schematic image;

wherein said personal digital assistant comprises:

an image processor that superimposes a symbol for indicating the position of said staking point on said schematic image in accordance with said correspondence.

27. A digital camera, comprising:

an imaging device that captures a schematic image of a surveying field which includes a staking point, for staking out surveying with a surveying instrument;

a position relation calculating processor that calculates a positional relation between said schematic image and said surveying instrument in accordance with two-dimensional position information of a plurality of

arbitrary designated control points on said schematic image, and one of three-dimensional measurement information of said plurality of control points measured by said surveying instrument and previously obtained measurement information;

a correspondence establishing processor that establishes correspondence of three-dimensional measurement information of a measurement point measured by said surveying instrument, and of three-dimensional position information of said staking point, to two-dimensional position information on said schematic image which corresponds to each of said measurement points and said staking point; and

an image-indicating device that indicates positions of said measurement point and said staking point on said schematic image, in accordance with said correspondence.

28. A digital camera according to claim 27, further comprising a data receiving processor that receives three-dimensional measurement information of a target, which is measured in order to carry out staking out surveying for said staking point, from said surveying instrument, and said image-indicating device indicates a position of said target on said schematic image.

29. A digital camera according to claim 28, wherein

said image-indicating device indicates a distance between said position of said target and said position of said staking point.

30. A digital camera according to claim 28, wherein said image-indicating device indicates a direction in which said target should be moved for said staking out surveying, on said schematic image.

31. A digital camera according to claim 27, further comprising an input device that enables a designation of a point on a screen of said image indicating device, wherein a position of said control point is arbitrarily designated on said schematic image displayed on said screen by using said input device.

32. A surveying supporting device, comprising:

a position relation calculating processor that calculates the position relation between a schematic image of a surveying field, which includes a staking point to be staked by using a surveying instrument, and said surveying instrument; and

a correspondence establishing processor that establishes correspondence of three-dimensional measurement information of a measurement point measured by said surveying instrument, and of three-dimensional position information of said staking point, to two-dimensional position information on said schematic image

which corresponds to each of said measurement points and said staking point;

wherein positions of said measurement point and said staking point are indicated on said schematic image in accordance with said correspondence.

33. A device according to claim 32, further comprising a data receiving processor that receives three-dimensional measurement information of a target, which is measured in order to carry out staking out surveying for said staking point, from said surveying instrument, and said image indicating device indicates a position of said target on said schematic image.

34. A device according to claim 33, wherein said image indicating device indicates a distance between said position of said target and said position of said staking point.

35. A device according to claim 33, wherein said image indicating device indicates a direction in which said target should be moved for said staking out surveying, on said schematic image.

36. A computer program product for supporting surveying, comprising:

position relation calculation means for calculating a positional relation between a schematic image of a surveying field including a staking point, and

a surveying instrument;

correspondence calculation means for calculating correspondence of three-dimensional measurement information of a measurement point measured by said surveying instrument, and of three-dimensional position information of said staking point, to two-dimensional position information on said schematic image which corresponds to each of said measurement points and said staking point; and

wherein of positions corresponding to said measurement point and said staking point on said schematic image are indicated in accordance with said correspondence.

37. A surveying method that comprises steps of:

capturing a schematic image of a surveying field including a staking point;

calculating a relation between said schematic image and a surveying instrument;

indicating a position of said staking point on said schematic image;

measuring three-dimensional measurement information of a target by using said surveying instrument in order to carry out staking out surveying for said staking point; and

indicating a position of said staking point on

said schematic image, in accordance with said relation, for guiding said target to said staking point.

38. A surveying system, comprising:

a position relation calculating processor that calculates a positional relation between a coordinate system to which measurement information of measurement points refer and a schematic image of a surveying field, in which said schematic image includes said measurement points;

a correspondence establishing processor that establishes correspondence between said measurement information of said measurement points and position information of points corresponding to said measurement points on said schematic image;

an image-indicating device that indicates said schematic image;

a measurement point indicating processor that indicates positions of said measurement points on said schematic image, which is displayed on said image indicating device, in accordance with said correspondence; and

a degeneracy informing processor that gives a position of a degenerated measurement point, when said position of said measurement point is degenerated on said schematic image displayed on said screen of said image

indicating device.

39. A system according to claim 38, further comprising a surveying device which is used to obtain said measurement information of said measurement points.

40. A system according to claim 38, wherein said position relation is calculated from a relation between measurement information of three or more than three arbitrary control points and position information of said control points on said schematic image.

41. A system according to claim 40, further comprising an input device that enables a designation of a point on said screen of said image indicating device, and wherein the positions of said control points are determined by designating arbitrary points on said schematic image by using said input device.

42. A system according to claim 40, wherein said measurement information of said control points comprises previously given geographic data.

43. A system according to claim 38, wherein said positional relation between said coordinate system and said schematic image is represented by exterior orientation parameters which include a position and an inclination of a camera when said schematic image is captured.

44. A system according to claim 38, wherein said

measurement information of said measurement points comprises one of staking point data for staking out surveying and previously given geographic data.

45. A system according to claim 38, further comprising a data recording processor that is able to associate and record said measurement information which relates to said measurement point and image data which relates to said schematic image.

46. A system according to claim 38, further comprising a digital camera for capturing said schematic image.

47. A system according to claim 38, wherein said degeneracy informing processor indicates a mark at said position, which represents said degenerated measurement points, on said schematic image.

48. A system according to claim 47, wherein said degeneracy informing processor changes a color of said mark in accordance with whether said degeneracy exist, so that said degeneracy of said measurement points is indicated.

49. A system according to claim 47, wherein said degeneracy informing processor changes a size of said mark in accordance with coordinate values corresponding to each of said degenerated measurement points, and in which said coordinate relates to the depth direction of

said schematic image.

50. A system according to claim 47, wherein said degeneracy informing processor changes a color of said mark in accordance with coordinate values corresponding to each of said degenerated measurement points, in which said coordinate relates to the depth direction of said schematic image.

51. A system according to claim 47, wherein said degeneracy informing processor changes a form of said mark in accordance with whether said degeneracy exists, so that said degeneracy of said measurement points is informed.

52. A system according to claim 51, wherein fletching lines of which the number corresponds to the number of said degenerated measurement points are drawn out from said mark representing said position of said degenerated measurement points.

53. A system according to claim 51, wherein the form of said mark corresponds to the number of said degenerated measurement points.

54. A system according to claim 53, wherein the form of said mark comprises a polygon that corresponds to the number of said degenerated measurement points, when said number of said degenerated measurement points is three or more than three.

55. A system according to claim 47, wherein said degeneracy informing processor changes a size of said mark in accordance with whether said degeneracy exist, so that said degeneracy of said measurement points is indicated.

56. A system according to claim 55, wherein said size of said mark corresponds to the number of said degenerated measurement points.

57. A system according to claim 38, further comprising an input device that enables a designation of a point on said screen of said image indicating device, and when an area including degenerated measurement points is designated by using said input device, said degeneracy informing processor indicates information relating to measurement points included in said area.

58. A system according to claim 57, wherein said information relating to said measurement points comprises a list of names and measurement information corresponding to said measurement points included in said area.

59. A system according to claim 57, wherein said information relating to said measurement points comprises image information corresponding to a magnified image of said area.

60. A system according to claim 57, wherein said information relating to said measurement points comprises

a bar graph that indicates said measurement points in accordance with coordinate values corresponding to each of said measurement points, in which said coordinate relates to the depth direction of said schematic image.

61. A system according to claim 38, wherein said measurement points indicated on said schematic image are projected to a predetermined plane, so that said measurement points are displayed as a form of plan view.

62. A system according to claim 61, wherein said predetermined plane comprises the horizontal plane.

63. A surveying supporting device, comprising:

a position relation calculating processor that calculates a positional relation between a coordinate system to which measurement information of measurement points refer and a schematic image of a surveying field, in which said schematic image includes said measurement points;

a correspondence establishing processor that establishes a correspondence between said measurement information of said measurement points and position information of points corresponding to said measurement points on said schematic image;

an image-indicating device that indicates said schematic image;

a measurement point indicating processor that

indicates positions of said measurement points on said schematic image, which is displayed on said image indicating device, in accordance with said correspondence; and

a degeneracy informing processor that gives positions of degenerated measurement points, when said positions of said measurement points are degenerated on said schematic image displayed on said screen of said image indicating device.

64. A computer program product for supporting surveying, comprising:

position relation calculation means for calculating a positional relation between a coordinate system to which measurement information of measurement points refer and a schematic image of a surveying field, in which said schematic image includes said measurement points;

correspondence calculation means for calculating correspondence between said measurement information of said measurement points and position information of points corresponding to said measurement points on said schematic image;

indication means for indicating said schematic image;

measurement point indication means for indicating

positions of said measurement points on said sch matic image, which is displayed on said image indicating device, in accordance with said correspondence; and

degenerated points means for giving a position of a degenerated measurement point, when said position of said measurement point is degenerated on said schematic image displayed on said screen of said image indicating device.